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Natural Versus Synthetic Rubber

A radio discussion over WGN and the Mutual Broadcasting System

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Recipient, Willard Gibbs Medal in Chemistry 1950

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Natural Versus Synthetic Rubber

MR. MCBURNEY: Our speakers today are Carl S. Marvel, Professor of Organic Chemistry at the University of Illinois and winner of the 1950 Willard Gibbs medal in chemistry, presented by the Chicago section of the American Chemical Society.

I am sure Dr. Marvel's colleagues in chemistry at Northwestern University would wish me to congratulate him on this distinction.

MR. MARVEL: Thank you.

MR. MCBURNEY: Joining Dr. Marvel are James P. McKenzie, Technical Director of the Copolymer Corporation at Baton Rouge, Louisiana; and H. A. Winkelmann, Technical Director of the Dryden Division of the Sheller Manufacturing Company.

Importance of Rubber

"In peace or war, industry, business, the home, and transportation on land, sea or air, cannot function without rubber." Today we tell the story of rubber, discuss the relative merits of natural and synthetic rubber, and consider programs for the development of reliable sources of supply.

Now, gentlemen, we all remember the rubber shortage during the last war. What is the story behind this? Did we face a serious rubber crisis during the war, Winkelmann?

MR. WINKLEMANN: In spite of the fact that the Reconstruction Finance Corporation started building a stockpile of natural rubber in 1939, when the outbreak of the war occurred in 1942 we found that we only had a stockpile of 553,000 long tons of natural rubber. That was less than a year's supply. For this reason we found ourselves in a very critical situation, and attempts that were made to control the usage and the manufacture of products from that natural rubber were most necessary; as a matter of fact, they probably were not stringent enough.

MR. MCBURNEY: What effect did the war have on the sources and supply of natural rubber, Dr. Marvel? I assume they dried up almost completely.

From Far East

MR. MARVEL: Yes. The natural rubber comes from the Far East, in general. That is the major place of production, and as soon as Pearl Harbor came we had no way of getting rubber from that source. We did manage to get an additional 100,000 long tons after this amount in stockpile was counted, before we actually began to produce synthetic rubber. But still we were very short, and during the war our stockpile got to a very critical stage. I think probably our biggest stockpile was not what the government had saved but what we had in the tires on the cars running on the road in this country, and that is one reason we had to curtail the use of cars.

MR. WINKLEMANN: I think it is interesting to point out, Marvel, that the low point of our rubber stockpile was about 93,000 tons, as published.

MR. MCBURNEY: How prepared were we with synthetic rubber, McKenzie?

MR. MCKENZIE: We didn't have very much synthetic. In fact, we didn't have any general purpose synthetic when the war broke out. We had Neoprene which is an oil resistant synthetic but nothing to take care of the cars in any volume whatsoever.

MR. MCBURNEY: Did we have plants in operation?

MR. MCKENZIE: We had no plants. There was a projected 10,000 ton plant to go in at Naugatuck, Connecticut by U. S. Rubber which the government was going to help finance, and that was rapidly increased approximately 800,000 tons within the next year after Pearl Harbor.

MR. MARVEL: We did have one other synthetic in small volume. I believe there was a synthetic rubber made by Goodrich. A few tires were produced from that before the war broke out.

Synthetic Production and War

MR. MCBURNEY: Before the war was over, how far did they carry this synthetic rubber production?

MR. MARVEL: We had at one time produced as much as one million tons of synthetic rubber in a year. I believe that was in 1945. This was approximately the full amount that we needed to keep tires on our cars and for the other rubber uses that we had to fulfill.

MR. MCBURNEY: About how many tons do we use in a normal year? I would like a comparison with this other figure that was given.

MR. WINKELMANN: As projected for this year, it would be about 600,000 tons of natural rubber and 460,000 tons of all synthetic compounds.

MR. MCBURNEY: This discussion naturally raises the question, to what extent should we try to depend on natural rubber for our plans in the future?

MR. MARVEL: We can get enough natural rubber for the critical uses, and we can make enough synthetic rubber to supplement that; so we will probably continue for a while at least to produce about one part of synthetics to two parts of natural for use in this country. We could increase that if we had to.

MR. WINKELMANN: The important thing is that we at all times be alert in building and keeping a stockpile of natural rubber.

MR. MCBURNEY: You mean that we have to have natural rubber? Can we get along without it?

MR. WINKELMANN: We have to have natural rubber for the construction of truck tires, airplane tires, foam sponge rubber, drug sundries, and rubber bands.

MR. MCBURNEY: You all agree with that?

MR. MCKENZIE: He said truck tires. I would say heavy-duty truck tires. For the small trucks we could get along without natural rubber.

Rubber for Tires

MR. MCBURNEY: How about the automobile tires, general passenger cars? What kind of rubber do you have on your car, Marvel?

MR. MARVEL: I use synthetic.

MR. MCBURNEY: You think it is superior?

MR. MARVEL: I think the tread is certainly superior. In passenger car tires the synthetic performs as well as any other.

MR. WINKELMANN: I think the synthetic, and by that I mean either the GR-S or the cold rubber process which is more uniform. Natural rubber disintegrates in processing as GR-S does not. You can build your products much more easily in the factory; you can handle it with greater precision than you can natural rubber.

MR. MCKENZIE: I use synthetic tires on my car entirely. I have all synthetic treads at least. There may be a little natural rubber but not very much.

MR. MCBURNEY: Why won't synthetic rubber work in these heavy-duty truck tires?

MR. MCKENZIE: You build up an enormous amount of heat in running heavy-duty truck tires at high speeds, and the internal friction of the molecules of synthetics are a little higher

than that of natural rubber. We just haven't gotten around to meeting that problem yet. Dr. Marvel has developed some experimentally at the University of Illinois which may get around that difficulty.

MR. MARVEL: I think it should be pointed out that rubber is a very poor conductor. In the small passenger car the heat can get out. In a large truck tire, it can't get out and begins to build up enough heat to affect the cords that are put in the tire. That is one of the things that gives us trouble in building heavy-duty tires, while in little tires we have satisfactory performance.

GR-S

MR. WINKELMANN: The reason for that heat buildup is the type of compounding that is necessary in making a GR-S tire. In the case of natural rubber, zinc oxide and whiting are used in the carcass, whereas in a GR-S the maximum physical properties can only be developed by the use of carbon blacks which increase the heat generation in the tire.

MR. MCBURNEY: What do you mean by GR-S, this term you use so frequently?

MR. WINKELMANN: GR-S means Government Rubber Styrene. That is the government terminology for general purposes.

MR. MCBURNEY: That is, a general utility synthetic?

MR. MARVEL: It is a general rubber, whereas the Butyl and Neoprene and Thiokol are more of the specialty rubber. They are also synthetics and are used, but the general purpose rubber is the GR-S, Government Rubber Styrene type.

MR. MCBURNEY: Why is it that in the summer time you have to let a little air out of these synthetic tires instead of adding a little?

MR. MCKENZIE: That is because in most of the new inner tubes of Butyl rubber the air test in the Butyl is ten times as good as that of natural rubber, so they don't leak air. In the old natural rubber tires, they leaked enough air so that you didn't get near the buildup.

MR. MCBURNEY: You think we are going to get accustomed to these synthetic inner tubes? You think they are here to stay?

MR. MCKENZIE: Yes, I think they are. We are not only getting accustomed to them but we are getting longer tire life because we don't run our tires only partially inflated.

MR. MCBURNEY: Let me ask you a bit about the pricing on these rubbers we are talking about. Is synthetic rubber cheaper than natural rubber? What is the price comparison?

Price Comparison

MR. WINKELMANN: Today natural rubber is considerably higher than synthetic rubber. In December, natural rubber was 17c a pound, spot; today it is about 28c, so that there has been a considerable increase in the price of the product.

MR. MARVEL: I might point out along that line, that synthetic has stayed at 18½c a pound during that time.

MR. MCBURNEY: How have subsidies affected these prices? Is there a concealed subsidy in the price of synthetic rubber?

MR. MARVEL: I would say not, although I am not an accountant and some people might disagree with me.

MR. MCBURNEY: Who is producing the synthetic rubber?

MR. MARVEL: The synthetic is all produced by the government, in one sense; that is, the government owns the plants, but they are leased to commercial companies who actually operate the plants. I think McKenzie perhaps can tell you more about that.

MR. MCBURNEY: How about that, McKenzie?

MR. MCKENZIE: According to the President's report on synthetic rubber, the cost, the synthetic over-all production of synthetic general purpose rubber, is 15.32c a pound. That includes amortization of the plant and interest on the money, and it is selling at 18½c. Rubber Reserve, which is the agency of the government that operates the synthetic plants, has made money every year since 1945.

MR. MCBURNEY: It is a great comfort to know that we have a government operation that is making some money.

MR. WINKELMANN: Prior to World War II, crude rubber could be profitably made and sold at from 6c to 8c. The present estimated cost is around 16c to 18c so that the two, GR-S and natural rubber, are not very far apart.

MR. MCBURNEY: Your natural rubber prices apparently have gone up precipitously.

MR. WINKELMANN: That has been due to the unsettled economic conditions in Indonesia and Malaya.

Increase Planting?

MR. MCBURNEY: Do you think it would be sound to increase the production of plantation rubber?

MR. WINKELMANN: Not at the present time with the unsettled conditions. For example, we understand that it would cost about $56 million to build a GR-S plant with a capacity of 100,000 pounds of synthetic. It would cost $80 million to build a plantation for an equivalent amount of rubber. That would require 270,000 acres of land, 24 million trees, and it would require about 90,000 people to man that plantation. There certainly isn't going to be any enthusiasm for capital to go out and invest in a plantation that will require seven years to mature.

MR. MARVEL: It should be pointed out that planting will be done a long way from home, and if anything goes wrong, we won't have any way to get the rubber back here when we need it. That is another disadvantage in increasing the natural rubber plantations.

MR. MCBURNEY: Apart from your enthusiasm for natural rubber for certain commercial uses, this discussion would seem to indicate that we might well expand our synthetic production; we might even consider getting out of the natural rubber market altogether. Is that a conclusion we are supposed to draw?

Increase Synthetic?

MR. MCKENZIE: No, I don't think so. I think there is a place for both. Our present production of synthetic rubber could be increased, say, 20 per cent more without increasing our cost, but if we go beyond that our costs will go up, because we have to get our raw materials from uneconomical sources. But I think there is a place for both. We've got to import natural rubber. We've got to import something to pay for our exports, or we are not going to export anything, and natural rubber is one thing that we can use economically.

MR. MCBURNEY: That puts it on a different basis. You say that we need imports to give people money to buy our exports?

MR. MCKENZIE: We need natural rubber, too, at the present time.

MR. MARVEL: That is what I wanted to point out. While we can make tires, even truck tires out of synthetic rubber, that will operate, the truck tires will not last as long. Even if we build them from 18½c a pound rubber, and make it cheaper than the 30c or 28c natural rubber, they wear out faster. It would not be economical to make those truck tires out of cheaper rubber if we don't get the wear. So we have to solve that heat buildup problem before we can say we are entirely free from natural rubber. If you are not going

to worry about costs, such as a situation when a war develops, and you have to live on what you can produce, then we are free of natural rubber supplies. We don't need them. But when you have to figure on what things cost, we are not ready to give up natural rubber.

'Effect of Moving Out'

MR. MCBURNEY: What people would be hurt if we were gradually to move out of this natural rubber market?

MR. WINKELMANN: The Malayans and Indonesians. That would be the Dutch East Indies and the British in Malaya. They would suffer the most, and French Indo-China and Thailand, Ceylon, which are the smaller producers.

MR. MCBURNEY: How were the plantations affected by the war? Are they in a thriving condition now?

MR. WINKELMANN: The collecting equipment was destroyed to a large extent, but the trees themselves were not harmed. There were a few chopped down but you cannot destroy a forest very easily. As a matter of fact, after about four or five years of rest, the trees gave more rubber for a while than they had ever given before. So that there was not a great deal of damage done in the long run.

MR. MCBURNEY: Apparently, judging from what McKenzie said earlier, there is a social problem here as well as an economic problem. Let's talk a bit more about these rubber plantations. What kind of wages do they pay? Would you say that natural rubber is a result of exploitation of the natives? What do you think of that, McKenzie?

MR. MCKENZIE: I think it definitely has been in the past, but I don't think you are going to kid those guys much longer because too many G.I.'s were over there with automobiles.

MR. WINKELMANN: About 65 per cent of all the rubber that is grown in Indonesia and Malaya is grown by people, little farmers who have less than 100 acres, so that you can't exploit them too much. There might be some exploitation in the larger estates. But these little fellows, it is their livelihood. It is the same as the farm lands here.

MR. MCBURNEY: In comparing prices on natural and synthetic rubber, it would be interesting to inquire into the wages paid in a synthetic rubber plant compared with those paid on these plantations. I don't know that we are prepared to do that. Do you have any comments on that, McKenzie?

MR. MCKENZIE: I don't know what the wages paid on plantations are now. I know they are considerably higher than they were before the war. Wages in a synthetic rubber plant for operating will average around $2.00 an hour.

MR. MCBURNEY: It seems completely clear that we stand to place considerable reliance on synthetic rubber. That is clear from what has been said.

Synthetic Rubber Research

I would like to ask Dr. Marvel about the status of research in synthetic rubber. You have been in that field, I know.

MR. MARVEL: Yes, I have been in that field since about 1942 when we started the government program of research. The research is financed by the Reconstruction Finance Corporation, through the office of Rubber Research and it is carried out in all of the major rubber companies who are in the pool. In addition to that, there are about seven or eight universities cooperating in this research group. I believe the budget in 1949 was about $7 million. The budget has been adjusted to the amount of rubber that the government is producing, so that the expense for research is part of the cost of rubber, done in good business fashion, as I understand it. I believe in this last year there was a little added expense due to military requirements which went beyond what might

be considered good business to invest back in the business of research. But outside of that, the research has been adequately supported by the Office of Rubber Research, and the program is very well coordinated. We work together very closely. It is impossible, I think, to say that any major development has come from any one laboratory. They have all shared ideas and worked together in a very satisfactory manner. McKenzie has had experience in that too. I think he can tell the same thing.

Government Control

MR. WINKELMANN: Would it be better to release that research to private industry and private initiative? It would probably get a little further than through government controlled cooperative efforts.

MR. MCBURNEY: What do you think, McKenzie?

MR. MCKENZIE: I definitely don't think so. As far as fundamental research is concerned, on a long-range basis, I think that private industry would do the same thing this time as they did after the 30's. As soon as natural rubber gets cheap enough they will quit as they did before. On a long-range basis, most of the people in Washington agree that the fundamental research is a function of the government. The developmental research, which we do in these various plants and pilot plants, should be a function of private industry.

MR. MARVEL: I think even private industry, once this industry is established, would be willing to do a considerable amount of fundamental work, but I think the rubber industry particularly is an uncertain industry. We have not only to produce rubber but we have to think about the security of the country. We have to worry about whether someone is going to decide that we should buy all of the natural rubber in order to keep us from spending more money on lend-lease. It is not lend-lease now but another way of helping.

MR. WINKELMANN: It is for that reason that we haven't had a chance to evaluate the position of GR-S against natural rubber; it is so intimately tied up with the national security problem.

MR. MARVEL: It probably will be some time before we can reach a place where we can settle this thing on a purely business basis.

'Stay in Rubber Business'

MR. MCBURNEY: We are to conclude then, in your judgment, the government ought to stay in the rubber business for a while, in fundamental research certainly, in, shall I call it, applied research probably, and in production less probably.

MR. MARVEL: I would say certainly stay in fundamental research. The government should stay in the field. In the other two, I would like to let somebody else settle that.

MR. WINKELMANN: I would like to see research continued, but I would like to see controls reduced to the minimum to see how much voluntary usage we can actually establish for the GR-S synthetics.

MR. MCKENZIE: I might say the government proposed to do some of that in some of the bigger companies but they didn't want it. They would rather have the government run the plants. So it is pretty hard to tell which way we should go. I agree with Marvel on the fundamental research. I think it is going to be a function of the government because of national security that is tied in with it.

MR. MCBURNEY: What do you think would happen to synthetic rubber on the open market if the government were to withdraw completely?

MR. MARVEL: I don't think that right now the amount required to be used is affecting the amount of synthetic rubber that is made. I believe we have been increasing the amount of synthetics made above that which is actually required because of the price differential. How long that would last

if we took over the equipment is another thing.

MR. WINKELMANN: We have been using over twice the amount of synthetic rubber that is required by law. In addition to that, I think it is interesting to ask the question: How would we have won the last war without synthetic rubber? I think you will find there is a definite place for synthetics.

MR. MCKENZIE: We definitely wouldn't have won the last war without rubber, and even last year for the full twelve months, the price of synthetic rubber was under that of natural by a considerable margin. The usage of synthetics was at least 50 per cent of the natural rubber usage.

MR. MCBURNEY: Do you recommend any great extension of our production facilities in synthetic rubber?

'Increase Production'

MR. MARVEL: My recommendation would be to increase our production of synthetic rubber to the maximum that we can carry, keeping the price where it is. If we have to introduce new sources of raw material that are going to make it more expensive, then I would hesitate to increase production of synthetic rubber. I think we've got to keep it in the competitive field.

MR. WINKELMANN: The price of GR-S has had a marked stabilizing influence. If it weren't for the price of GR-S at 81½c, f.o.b. plant, we would have a dollar natural rubber today.

MR. MCBURNEY: Do we have the raw materials in this country for the production of GR-S and these other synthetics?

MR. MCKENZIE: I think so very definitely. Most of them are of petroleum, and the petroleum industry, if called upon, can make almost anything, depending on what you want. The Japanese used natural rubber to make gasoline. We went the other way.

MR. MCBURNEY: When you talked about these synthetic rubbers, Winkelmann, you referred repeatedly to this GR-S. That is a general utility synthetic rubber. I take it we are dealing with varieties of synthetics and any comparison between natural and synthetic must consider those different types.

MR. WINKELMANN: Yes, there are other synthetic rubbers. For example, there is a synthetic rubber for each purpose that will do a job functionally that no natural rubber compound can do. Synthetic rubber has chemical resistance to ozone that natural rubber doesn't have. The only exception is in the carcass of a truck tire.

MR. MCBURNEY: Which I take to be a very important exception.

In brief conclusion, what policies do you recommend for the development of an adequate rubber supply?

'Continue Research'

MR. MARVEL: I should say continue fundamental research until we find a rubber that can be used in the carcass of a truck tire.

MR. MCBURNEY: In the heavy-duty tire?

MR. WINKELMANN: I would continue government operation of the synthetic rubber plants, with the idea of releasing control and turning them over to private industry so synthetic rubber can find its own level against natural rubber.

MR. MCKENZIE: My personal opinion is that they ought to, as soon as possible, turn the plants over to private industry, but keep the fundamental research as a function of government.

MR. MCBURNEY: Thank you, gentlemen. I think this has been an interesting discussion of a problem which could easily become critical in an international crisis, and one which is, I think, of considerable importance in times of peace.

Suggested Readings

Compiled by Barbara Wynn, Assistant, Reference Department, Deering Library, Northwestern University

HOWARD, FRANK, and THERTON, A. *Buna Rubber: The Birth of an Industry.* New York, Van Nostrand, 1947.

The story of the synthetic rubber industry.

Rubber. *First Annual Report by Secretary of Commerce.* April 1, 1948-March 31, 1949. Washington, D. C., Government Printing Office, 1949.

First annual report covering operations under the Rubber Act of 1948. Includes information on U. S. rubber consumption, world natural rubber production, synthetic rubber industry, etc.

U. S. President. *Synthetic Rubber; Recommendations of the President, Transmitted to Congress together with a Report on Maintenance of the Synthetic Rubber Industry in the United States and Disposal of Government-Owned Synthetic Rubber Facilities, from the Assistant to the President.* January, 1950. Washington, D. C., Government Printing Office, 1950.

The Steelman report. Discusses the background of the rubber program and the current status of synthetic and natural rubbers, including supply, demand, cost of production, and competitive status of the synthetic rubber industry.

WILSON, CHARLES MORROW. *Trees and Test Tubes; The Story of Rubber.* New York, H. Holt and Co., 1943.

A dramatic account of the rubber industry from its beginnings to post-Pearl Harbor days.

Aero Digest 54:28-9, My., '47. "Rubber and National Security." J. L. COLLYER.

Stresses the importance of synthetic rubber to the future defense of the United States.

Chemical and Engineering News 27:27-8, Ja. 3, '49. "Rubber in 1948; Synthetic Rubber Quality Shows Improvement." G. B. HADLOCK and others.

Discusses recent developments in synthetic rubber.

Fortune 37:92-5+, Je., '48. "Report from Singapore." C. BURCK.

Predicts that if the U. S. runs into a depression, or for any other reason stops buying Malayan rubber at a fair price, it will mean the loss of the West's greatest stronghold against Communism in southeast Asia.

Fortune 35:114-19+, Je., '47. "Trouble in Synthetic Rubber."

An interesting account of the postwar synthetic rubber industry, and of the work of John L. Collyer and the B. F. Goodrich Company in promoting the development of synthetic rubber.

Fortune 38:82-9+, Jl., '48. "Great Merchant Adventurer."

Describes the problems faced by the natural rubber business.

Land Economics 24:89-94, F., '48. "Synthetics vs. Singapore." A. G. SMITH.

Opposed to government subsidization of the synthetic industry, tells why the United States should import natural rubber rather than strive for self-sufficiency in rubber.

Modern Industry 19:42-6, F., '50. "Synthetic vs. Natural Rubber; Users Can't Lose."

Although natural rubber producers are attacking the growing markets of the synthetic producers, both are improving quality and are offering greater varieties of goods at lower prices.

New York Times Magazine p. 60-1+, My. 15, '49. "Revolution in Rubber." B. JAFFE.

Survey of the events leading to the development of synthetic rubber and of the present-day results. Contends that eventually natural rubber will succumb to cheaper man-made rubber.

Popular Science 153:153-8, S., '48. "Your Next Tire May Be a Lucky Wonder; Cold Rubber." C. STEVENSON and A. P. ARMAGNAC.

An explanation and description of the so-called "cold rubber." Declares that with "cold rubber" the synthetic industry can stand on its own feet, assured of a permanent future.

Scientific Monthly 58:5-15, Ja., '44. "Synthetic Rubber." E. R. GILLIAND.

A discussion of the three types of rubber produced under the U. S. wartime program, GR-S, GR-I and GR-M.

Scientific Monthly 66:221-31, Mr., '48. "Eighty-Eight Years of Synthetic Rubber." R. F. WOLF.

Maintains that eighty-eight years have only brought synthetic rubber to the threshold of maturity, and that competition with natural rubber will stimulate better and cheaper synthetic rubbers.

Social Studies 36:344-8, D., '45. "The Story of Rubber." R. C. HACKETT.

A general history of the development of rubber as an industrial commodity, and of the invention and development of artificial rubber.

United Nations World 2:60-4, Je., '48. "The Unpredictable Commodity."

Describes the tremendous price fluctuations of rubber in the past, and the probable influence of synthetic rubber on the price of natural rubber.

United States News 28:32-5, Mr. 24, '50. "Rubber: Needs for Peace and War; Interviews with P. W. Litchfield."

Points out that the supply of natural rubber is again jeopardized by the current turmoil in southeast Asia, and that, for security, America needs an output of 200,000 tons of synthetic rubber a year.

United States News 28:36-40, Ja. 6, '50. "World Outlook in Rubber; Interview with J. L. Collyer."

The president of the B. F. Goodrich Company discusses progress in rubber since the war, the new era of competition between natural and synthetic rubber, and the effects of the devaluation of the British pound on the price of natural rubber.

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